

4. (Amended) Display device according to claim 1,
~~characterized in that~~ wherein the protective coating of ~~lacquer~~ is
a plain lacquer and consists of an acryl base and a synthetic
agent.

5. (Amended) Display device according to claim 4,
~~characterized in that the~~ wherein a mixing proportion between the
acryl base and the synthetic agent is 10:1.

IN THE CLAIMS:

Please cancel claim 6 without prejudice or disclaimer. Please amend claims 1-5 as follows:

1. (Amended) Display device comprising:

- a sheet-like support covered with a layer of liquid thermocromic crystals,
- the liquid thermocromic crystals being separately tempered by an individual power supply to individual heatable elements,
- the individual heatable elements being close to the liquid thermocromic crystals and being placed between the sheet-like support and the liquid thermocromic crystals,
- the liquid thermocromic crystals assuming different shades of color dependent on a given temperature so that the color of the liquid thermocromic crystals will form a certain pattern and a figure,
- the liquid thermocromic crystals being distributed over a complete layer without a specific pattern and a design of the figure being determined only by tempering the individual heatable elements located according to said design, and
- a cooling device controlled to cool down the liquid thermocromic crystals to ascertain temperature lower than the given temperature, the liquid thermocromic crystals being covered by a protective coating.

2. (Amended) Display device according to claim 1, wherein the individual heatable elements consist of peltier elements supplied by electricity to set their temperature.

3. (Amended) Display device according to claim 2, wherein the liquid thermocromic crystals are painted on the peltier elements.

4. (Amended) Display device according to claim 1, wherein the protective coating is a plain lacquer and consists of an acryl base and a synthetic agent.

5. (Amended) Display device according to claim 4, wherein a mixing proportion between the acryl base and the synthetic agent is 10:1.

CLAIMS

1. Display device consisting of a sheet-like support (1) which is covered with liquid thermocromic crystals (2), which are separately tempered by individual power supply to individual heatable elements (3), which lie close to the crystals and are placed between the sheet-like support (1) and the crystals (2), whereby the crystals assume different shades of colour dependent on the given temperature so that hereby the colour of the crystals will form a certain pattern, characterized by that, the crystals have underlying means (4) which are controlled to cool down the crystals (2) and/or keep the sheet-like support (1) of the crystals at a certain temperature, which is lower than the temperature, at which the crystals are coloured and further characterized in that the crystals are covered by a coating of lacquer over the complete sheet-like support.

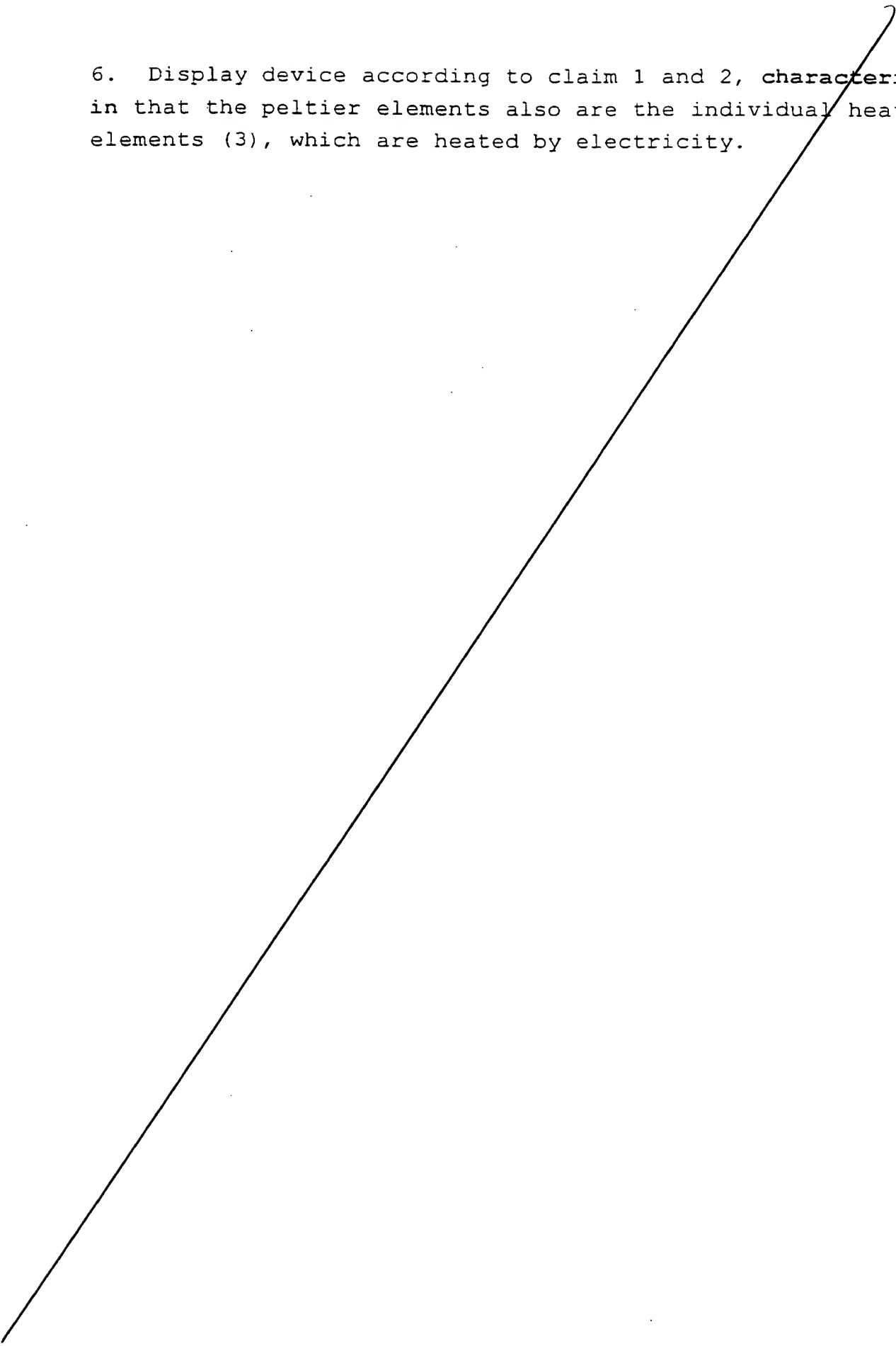
2. Display device according to claim 1, characterized in that the underlying means consists of peltier elements, which are black and are supplied by electricity in order to set their temperature.

3. Display device according to claim 2, characterized in that the liquid thermocromic crystals are painted on the peltier elements.

4. Display device according to claim 1, characterized in that the coating of lacquer is a plain lacquer and consists of an acryl base and a synthetic agent.

5. Display device according to claim 4, characterized in that the mixing proportion between the acryl base and the synthetic agent is 10:1.

6. Display device according to claim 1 and 2, characterized in that the peltier elements also are the individual heatable elements (3), which are heated by electricity.



REMARKS

In the Office Action, the drawings are objected to under 37 CFR 1.83(a). The disclosure was objected to. Claim 1 was objected to. Claims 2 and 4 were objected to. Claim 1 was rejected under 35 USC §112, second paragraph. Claims 1-3 and 6 were rejected under 35 USC §102(b) as being anticipated by O'Brian. Claim 4 was rejected under 35 USC §103(a) as being unpatentable over O'Brian in view of Sheets. Claim 5 was rejected under 35 USC §103(a) as being unpatentable over O'Brian in view of Sheets and further in view of Jung et al.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings To Show Changes Made".

In response to paragraph 3 of the Official Letter, Fig. 3 shows the sheet-like support 1 separately and in Fig. 2 the sheet-like support 1 is between the two most lowest lines. See the enclosed drawing correction, in which (1) has been inserted in Fig. 2.

The present invention relates to a display device consisting of a sheet-like support, covered with a layer of liquid thermocromic crystals, which are separately tempered by an individual power supply to individual heatable elements lying close to the liquid thermocromic crystals and placed between the sheet-

like support and the liquid thermocromic crystals. The liquid thermocromic crystals assume different shades of color dependent on the given temperature so that hereby the color of the liquid thermocromic crystals will form a certain pattern and a figure.

U.S. Patent No. 4,142,782 to O'Brian discloses a display arrangement. The display arrangement includes a sheet-like metallic support provided with areas of different thermocromic compositions. As this display arrangement is heated or cooled the areas will change in color when the temperatures within these areas changes sufficiently to cause a color change. The transition temperatures varies with the thermocromic compound or composition used in those areas.

The display device of the present invention, however, differs substantially from the display arrangement of the O'Brian patent. The inventive idea of the present invention is that the display device may show an arbitrary figure where the design of the figure is formed only by these heatable elements being tempered by heating elements, and which are located according to said design. The inventive idea of the present invention further includes that the support includes a cooling device which is controlled to cool down the liquid thermocromic crystals and/or keep the support of the crystals at a certain temperature, which is lower than the temperature at which the liquid thermocromic crystals are colored. It is thereby possible to very quickly change from one arbitrary

figure to another arbitrary figure. The present invention further allows a very sharp figure since the temperature of the support can be kept at a certain degree irrespective of the surrounding temperature, and thereby keep all the liquid thermocromic crystals that does not constitute part of the figure at a certain color. This is not accomplished in the O'Brian patent.

According to the O'Brian patent, the design of the figures will appear in accordance with the location of the thermocromic crystals. The thermocromic crystals, however, are located in different, specific areas in specific patterns as can be seen from the figures. Thus, it is only possible to shift from one figure to a different figure in dependence of the particular pattern of the thermocromic crystals on the metallic support. These patterns thus substantially limit the kinds of figures that may be presented on the display arrangement. For example, in fig. 4, of which fig. 5 constitutes a partial cross sectional view, the display arrangement includes a support having a surface which carries elongated striplike electrical resistance elements. The resistance elements are covered by areas of various thermocromic crystal compositions. The areas of thermocromic crystal compositions however, are as can be seen in the figures only present on the elongated striplike resistance elements. Thus the kinds of possible figures are considerably limited.

In conclusion, the O'Brian patent does not disclose a display device where the liquid thermocromic crystals are distributed over a complete layer covering the support and without a specific pattern, where the design of the figure is determined only by tempering the small heatable elements which are located according to said design, and where the support includes a cooling device that is controlled to cool down the liquid thermocromic crystals and/or keep the support of the crystals at a certain temperature, which is lower than the temperature, at which the liquid thermocromic crystals are colored. The advantages of the present invention over what the cited references teach are stated on page 4, from line 24 to the end of the specification.

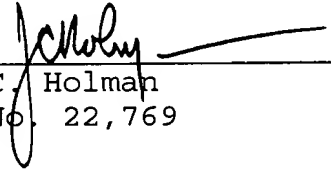
Based on the foregoing amendments and remarks, it is respectfully submitted that the claims in the present application, as they now stand, patentably distinguish over the references cited and applied by the Examiner and are, therefore, in condition for allowance. A Notice of Allowance is in order, and such favorable action and reconsideration are respectfully requested.

However, if after reviewing the above amendments and remarks, the Examiner has any questions or comments, he is cordially invited to contact the undersigned attorneys.

Respectfully submitted,

JACOBSON HOLMAN, PLLC

By: _____


John C. Holman
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Date: March 6, 2003
JLS/dmt

B5
cont
crystals are covered by a coating of lacquer over the complete sheet-like support.

IN THE CLAIMS:

Please cancel claim 6 without prejudice or disclaimer.

Please amend claims 1-5 as follows:

1. (Amended) Display device comprising:

B6
a sheet-like support covered with a layer of liquid thermocromic crystals, the liquid thermocromic crystals being separately tempered by an individual power supply to individual heatable elements, the individual heatable elements being close to the liquid thermocromic crystals and being placed between the sheet-like support and the liquid thermocromic crystals, the liquid thermocromic crystals assuming different shades of color dependent on a given temperature so that the color of the liquid thermocromic crystals will form a certain pattern and a figure, the liquid thermocromic crystals being distributed over a complete layer without a specific pattern and a design of the figure being determined only by tempering the individual heatable elements located according to said design, and a cooling device controlled to cool down the liquid thermocromic crystals to a certain temperature lower than the given temperature, the liquid thermocromic crystals being covered by a protective coating.

2. (Amended) Display device according to claim 1, wherein the individual heatable elements consist of peltier elements supplied by electricity to set their temperature.

3. (Amended) Display device according to claim 2, wherein the liquid thermocromic crystals are painted on the peltier elements.

B6
4. (Amended) Display device according to claim 1, wherein the protective coating is a plain lacquer and consists of an acryl base and a synthetic agent.

5. (Amended) Display device according to claim 4, wherein a mixing proportion between the acryl base and the synthetic agent is 10:1.

Serial No. : 09/529,401
Atty. Docketing No. : P65317US0

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Please amend the specification as follows:

Please insert the following paragraph on page 1, before
line 3.

--Field of the Invention--

Please insert the following paragraph on page 1, before
line 12.

--Background of the Invention--

Please insert the following paragraph on page 2, before
line 15.

--Summary of the Invention--

Please insert the following paragraph on page 2, before
26.

--Brief Description of the Drawings--

Please insert the following paragraph on page 2, before
line 34.

--Detailed Description of the Preferred Embodiments--

Please replace the paragraph beginning at page 3, line 22 with the following rewritten paragraph.

-- The thermocromic crystals are covered by a coating of lacquer 5 in order to protect the crystals ~~to~~ from the surroundings, the composition of said coating of lacquer being stated later. --

Please replace the paragraph beginning at page 4, line 1 with the following rewritten paragraph.

-- This is illustrated in fig. 3 by that the sheet-like support 1 has one or several continuous channels or is designed like a jacket so that the sheet-like support is ~~hallow~~ hollow whereby a cooling medium 4 can pass through the sheet-like support and keep it at a constant temperature or lower the temperature for the complete display device. --

IN THE ABSTRACT:

Please amend the Abstract of the Disclosure as follows.

-- **ABSTRACT OF THE DISCLOSURE**

A known display device consists of a sheet-like support ~~(1)~~ which is covered with liquid therochromic crystals ~~(2)~~. ~~These~~ The crystals are tempered by individual power supply to individual heatable elements ~~(3)~~, which lie close to the crystals and are placed between the sheet-like support ~~(1)~~ and the crystals ~~(2)~~. The crystals assume different shades of colour dependent on the

given temperature so that hereby the colour of the crystals will form a certain pattern. In order to improve the possibilities to control the tempering of the individual crystals and also protect them from being effected by the ambient temperature and from mechanical damage, the crystals have an underlying ~~means~~ (4) arrangement which ~~are~~ is controlled to cool down th crystals (2) and/or keep the sheet-like support (1) of the crystals at a certain temperature. This temperature is lower than the temperature, at which the crystals are coloured. Further the crystals are covered by a coating of lacquer over the complete sheet-like support.

IN THE CLAIMS:

Please cancel claim 6 without prejudice or disclaimer.

Please amend claims 1-5 as follows:

1. (Amended) Display device ~~consisting of~~ comprising:
a sheet-like support (1) ~~which is~~ covered with a layer of liquid thermocromic crystals (2), ~~which are~~ the liquid thermocromic crystals being separately tempered by an individual power supply to individual heatable elements (3), ~~which lie~~ the individual heatable elements being close to the liquid thermocromic crystals and ~~are being~~ placed between the sheet-like support (1) and the liquid thermocromic crystals (2), ~~whereby~~ the liquid thermocromic crystals ~~assume~~ assuming different shades of ~~colour~~ color dependent on the

a given temperature so that hereby the ~~colour~~ color of the liquid thermocromic crystals will form a certain pattern and hereby a figure ~~characterized by that~~, the liquid thermocromic crystals (2) ~~are being~~ distributed over ~~the~~ a complete layer without a specific pattern and ~~that the~~ a design of the figure ~~is being~~ determined only by tempering the ~~small~~ individual heatable elements (3), ~~which are located according to said wanted design, and by that the support includes a cooling means (4) which are device controlled to cool down the liquid thermocromic crystals (2) and/or keep the support (1) of the crystals at to a certain temperature, which is lower than the given temperature, at which the crystals are coloured and whereat the liquid thermocromic crystals are being covered by a protective coating.~~

2. (Amended) Display device according to claim 1, ~~characterized in that the underlying means consists wherein the individual heatable elements consist of peltier elements, which are black and are supplied by electricity in order to set their temperature.~~

3. (Amended) Display device according to claim 2, ~~characterized in that wherein the liquid thermocromic crystals are painted on the peltier elements.~~

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01906

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G02F 1/13, G09F 9/35

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G02F, G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5202677 A (ROBERT PARKER ET AL.), 13 April 1993 (13.04.93), column 14, line 60 - column 15, line 8, figure 15 --	1,4,5
Y	US 4142782 A (EDWARD D. O'BRIAN), 6 March 1979 (06.03.79), column 4, line 35 - line 47, figure 3 --	1,4,5
Y	GB 2199981 A (LIQUID CRYSTAL DEVICES LIMITED), 20 July 1988 (20.07.88), page 10, line 35 - page 11, line 12 --	1,4,5

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

27 January 1999

01-02-1999

Name and mailing address of the ISA/
Swedish Patent Office
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Gordana Ninkovic
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE.98/01906

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4834500 A (KERR, BERKSHIRE ET AL.), 30 May 1989 (30.05.89), column 2, line 23 - column 3, line 26 --	1-6
A	US 5124819 A (FREDERICK DAVIS), 23 June 1992 (23.06.92), column 2, line 27 - column 3, line 24 -- -----	1-6

INTERNATIONAL SEARCH REPORT

Information on patent family members

21/12/98

International application No.

PCT/SE '98/01906

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
US	5202677	A	13/04/93	AU	1361892 A	07/09/92
				WO	9214234 A	20/08/92

US	4142782	A	06/03/79	NONE		

GB	2199981	A	20/07/88	NONE		

US	4834500	A	30/05/89	EP	0132077 A,B	23/01/85
				GB	2143323 A,B	06/02/85
				JP	1853498 C	07/07/94
				JP	60052890 A	26/03/85

US	5124819	A	23/06/92	US	4952033 A	28/08/90
				US	5058999 A	22/10/91

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶: G02F 1/13, G09F 9/35	A1	(11) International Publication Number: WO 99/21049 (43) International Publication Date: 29 April 1999 (29.04.99)
(21) International Application Number: PCT/SE98/01906 (22) International Filing Date: 21 October 1998 (21.10.98) (30) Priority Data: 9703851-7 22 October 1997 (22.10.97) SE (71)(72) Applicant and Inventor: ANDERSSON, Lars [SE/SE]; P.O. Box 14129, S-161 14 Bromma (SE). (74) Agents: MODIN, Jan et al.; Axel Ehmers Patentbyrå AB, P.O. Box 10316, S-100 55 Stockholm (SE).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>
(54) Title: DISPLAY DEVICE <div> </div> (57) Abstract <p>A known display device consists of a sheet-like support (1) which is covered with liquid thermochromic crystals (2). These are tempered by individual power supply to individual heatable elements (3), which lie close to the crystals and are placed between the sheet-like support (1) and the crystals (2). The crystals assume different shades of colour dependent on the given temperature so that hereby the colour of the crystals will form a certain pattern. In order to improve the possibilities to control the tempering of the individual crystals and also protect them from being effected by the ambient temperature and from mechanical damage, the crystals have underlying means (4) which are controlled to cool down the crystals (2) and/or keep the sheet-like support (1) of the crystals at a certain temperature. This temperature is lower than the temperature, at which the crystals are coloured. Further the crystals are covered by a coating of lacquer over the complete sheet-like support.</p>		

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ _____

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only

Identification of IPEA

Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION

Applicant's or agent's file reference
23116-PC/Big

International application No.
PCT/SE98/01906

International filing date (day/month/year)
21 October 1998

(Earliest) Priority date (day/month/year)
22 October 1997

Title of invention

DISPLAY DEVICE

Box No. II APPLICANT(S)

Name and address: (Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)

Lars Andersson
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Sweden

Telephone No.:

Facsimile No.:

Teleprinter No.:

State (that is, country) of nationality:

Sweden

State (that is, country) of residence:

Sweden

Name and address: (Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)

State (that is, country) of nationality:

State (that is, country) of residence:

Name and address: (Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)

State (that is, country) of nationality:

State (that is, country) of residence:



Further applicants are indicated on a continuation sheet.

Box No. III AGENT OR COMMON REPRESENTATIVE: OR ADDRESS FOR CORRESPONDENCEThe following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country.)*

BILLBERG, Hans; MODIN, Jan; SÄFWENBERG, Björn;
 JANSON, Ronny; SVAHN, Stefan; UGGLA, Niclas;
 HULTMAN, Olle
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Facsimile No.:

+ 46 8 661 88 62

Teleprinter No.:

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION****Statement concerning amendments:***

1. The applicant wishes the international preliminary examination to start on the basis of:

☒ the international application as originally filedthe description ☐ as originally filed☐ as amended under Article 34the claims ☐ as originally filed☐ as amended under Article 19 (together with any accompanying statement)☐ as amended under Article 34the drawings ☐ as originally filed☐ as amended under Article 342. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.3. ☐ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.☐ which is the language of a translation furnished for the purposes of international search.☐ which is the language of publication of the international application.☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.**Box No. V ELECTION OF STATES**The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)*

excluding the following States which the applicant wishes not to elect:

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:

- | | | |
|--|---|--------|
| 1. translation of international application | : | sheets |
| 2. amendments under Article 34 | : | sheets |
| 3. copy (or, where required, translation) of amendments under Article 19 | : | sheets |
| 4. copy (or, where required, translation) of statement under Article 19 | : | sheets |
| 5. letter | : | sheets |
| 6. other (specify) | : | sheets |

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received not received

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

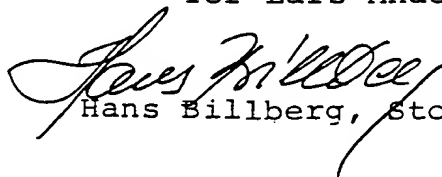
The demand is also accompanied by the item(s) marked below:

- | | |
|--|---|
| 1. <input checked="" type="checkbox"/> fee calculation sheet | 4. <input type="checkbox"/> statement explaining lack of signature |
| 2. <input type="checkbox"/> separate signed power of attorney | 5. <input type="checkbox"/> nucleotide and or amino acid sequence listing in computer readable form |
| 3. <input type="checkbox"/> copy of general power of attorney; reference number, if any: | 6. <input type="checkbox"/> other (specify): |

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

for Lars Andersson



Hans Billberg, Stockholm May 21, 1999

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply.

☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

Ehrners

1998 -12- 1 0

received**TENT COOPERATION TR****PCT**

From the INTERNATIONAL BUREAU

To:

MODIN, Jan
 Axel Ehrners Patentbyrå AB
 P.O. Box 10316
 S-100 55 Stockholm
 SUÈDE

**NOTIFICATION CONCERNING
 SUBMISSION OR TRANSMITTAL
 OF PRIORITY DOCUMENT**

(PCT Administrative Instructions, Section 411)

Date of mailing (day/month/year) 03 December 1998 (03.12.98)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 23116-PC/Big	
International application No. PCT/SE98/01906	International filing date (day/month/year) 21 October 1998 (21.10.98)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 22 October 1997 (22.10.97)
Applicant ANDERSSON, Lars	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, the attention of the applicant is directed to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
22 Octo 1997 (22.10.97)	9703851-7	SE	30 Nove 1998 (30.11.98)

The International Bureau of WIPO
 34, chemin des Colombettes
 1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Juan Cruz

Telephone No. (41-22) 338.83.38

PCT

**NOTICE INFORMING THE APPLICANT OF THE
COMMUNICATION OF THE INTERNATIONAL
APPLICATION TO THE DESIGNATED OFFICES**

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

MODIN, Jan
Axel Ehrners Patentbyrå AB
P.O. Box 10316
S-100 55 Stockholm
SUÈDE



Date of mailing (day/month/year)

29 April 1999 (29.04.99)

Applicant's or agent's file reference

23116-PC/Big

IMPORTANT NOTICE

International application No.

PCT/SE98/01906

International filing date (day/month/year)

21 October 1998 (21.10.98)

Priority date (day/month/year)

22 October 1997 (22.10.97)

Applicant

ANDERSSON, Lars

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
AU,CN,EP,IL,JP,KP,KR,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:

AL,AM,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EE,ES,FI,GB,GE,GH,GM,HR,HU,ID,IS,KE,
KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,
TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on 29 April 1999 (29.04.99) under No. WO 99/21049

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

J. Zahra

Telephone No. (41-22) 338.83.38

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 23116-PC/BIG	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. SE98/01906	International filing date (day/month/year) 21-10-1998	Priority date (day/month/year) 22-0-1997
International Patent Classification (IPC) or national classification and IPC: G02F 1/13; G09F 9/35		
Applicant Andersson, Lars		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>2</u> sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the report</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>

Date of submission of the demand 21-05-1999	Date of completion of this report 2000-03-30
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Lars Jakobsson /itw Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

1. Basis of the report

1 This report has been drawn on the basis of (Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)

- ☐ the international application as originally filed.
- ☒ the description, pages 1-5, as originally filed.
pages _____, filed with the demand.
pages _____, filed with the letter of _____.
pages _____, filed with the letter of _____.
- ☒ the claims, Nos. _____, as originally filed.
Nos. _____, as amended under Article 19.
Nos. _____, filed with the demand.
Nos. 1-6, filed with the letter of 24-03-2000.
Nos. _____, filed with the letter of _____.
- ☒ the drawings, sheets/fig _____, as originally filed,
sheets/fig _____, filed with the demand.
sheets/fig 1-3, filed with the letter of _____.
sheets/fig _____, filed with the letter of _____.

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims	<u>1-6</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-6</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-6</u>	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates to a display device comprising a sheet-like support, which is covered by a layer of independently controlled elements of liquid thermochromic crystals. The object of the invention is to increase possibilities to control tempering of individual crystals to obtain an arbitrary dynamic image and decrease sensitivity to ambient temperature as well as mechanical damage.

The solution according to the invention comprises underlying means for cooling the individual crystals, distributed over the complete layer without a specific pattern, and the sheet-like support to a certain temperature, which is lower than the temperature at which the crystals are coloured.

New amended claims were filed with the letter of 24.03.2000.

The following documents were cited in the International Search Report:

D1: US4142782 A
D2: US5202677 A
D3: GB2199981 A
D4: US4834500 A
D5: US5124819 A

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

Documents D1-D3 are of particular relevance, while documents D4-D5 represent the general state of art.

In document D1 (see column 4, line 35-column 5, line 25; Fig.3-6)

a display device is disclosed consisting of a sheet-like support, which is covered with a layer of thermochromic crystals. Tempering of thermochromic compositions in certain elongated areas can be individually controlled by striplike electrical resistance elements. The display arrangement also utilises a block (support) with channels parallel to and adjacent to the resistance elements. An appropriate heating or cooling fluid such as air or water may be circulated through any or all of these channels in order to convey heat either to or away from the resistance elements and thus the thermochromic areas (see Fig. 6).

In document D2 (see column 14, line 60-column 15, line 8; column 19, line 55-64; Fig. 15) a display apparatus is disclosed, using one or more thermochromic images mounted on a heatable substrate. In an embodiment, a back air gap, to promote uniform heating or cooling of the display, is provided between the visual display and the back plate.

In document D3 (see page 10, line 35- page 11, line 12) a temperature responsive display device incorporating areas of thermochromic compositions, is disclosed. An embodiment involves covering the various regions of thermochromic liquid crystal compositions with a clear lacquer.

The closest prior art is found in document D1. The invention according to amended claim 1 differs mainly from what is disclosed in document D1 in that the thermochromic crystals are distributed over the complete layer without a specific pattern.

However, there are no clear indications in document D1 or in documents D2-D3 to use the technical features disclosed to display an arbitrary dynamic image. Consequently, the invention according to new claims 1-6 is novel (N), and is also considered to involve an inventive step (IS) and to have industrial applicability (IA).

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

CT/ SE 98 / 01906

International Application No.

International Filing Date

21 -10- 1998

The Swedish Patent Office
PCT International Application

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference

(if desired) (12 characters maximum)

23116-PC/Big

Box No. I TITLE OF INVENTION

DISPLAY DEVICE

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is country) of residence if no state of residence is indicated below.)

Lars Andersson
Box 14129
S-161 14 BROMMA
Sweden

☒ This person is also inventor

Telephone No.

Facsimile No.

Teleprinter No.

State (that is country) of nationality:

Sweden

State (that is country) of residence:

Sweden

This person is applicant for the purposes of:



all designated States



all designated States except the United States of America



the United States of America only



the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is country) of residence if no state of residence is indicated below.)

This person is:



applicant only



applicant and inventor



inventor only (If this check-box is marked, do not fill in below.)

State (that is country) of nationality:

State (that is country) of residence:

This person is applicant for the purposes of:



all designated States



all designated States except the United States of America



the United States of America only



the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:



agent



common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

AXEL EHRNERS PATENTBYRÅ AB and MODIN, Jan;
SÄFWENBERG, Björn, BILLBERG, Hans;
JANSON, Ronny; SVAHN, Stefan; UGGLA, Niclas;
HASSELGREN, Joakim; HULTMAN, Olle

Box 10316

S-100 55 STOCKHOLM,
Sweden

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+46 8 459 18 00

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Teleprinter No.

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

21-10-1998

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

Regional Patent

- ☐ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- | | |
|--|--|
| <input checked="" type="checkbox"/> AL Albania | <input checked="" type="checkbox"/> LS Lesotho |
| <input checked="" type="checkbox"/> AM Armenia | <input checked="" type="checkbox"/> LT Lithuania |
| <input checked="" type="checkbox"/> AT Austria | <input checked="" type="checkbox"/> LU Luxembourg |
| <input checked="" type="checkbox"/> AU Australia | <input checked="" type="checkbox"/> LV Latvia |
| <input checked="" type="checkbox"/> AZ Azerbaijan | <input checked="" type="checkbox"/> MD Republic of Moldova |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina | <input checked="" type="checkbox"/> MG Madagascar |
| <input checked="" type="checkbox"/> BB Barbados | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> BG Bulgaria | |
| <input checked="" type="checkbox"/> BR Brazil | <input checked="" type="checkbox"/> MN Mongolia |
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| <input checked="" type="checkbox"/> CN China | <input checked="" type="checkbox"/> NZ New Zealand |
| <input checked="" type="checkbox"/> CU Cuba | <input checked="" type="checkbox"/> PL Poland |
| <input checked="" type="checkbox"/> CZ Czech Republic | <input checked="" type="checkbox"/> PT Portugal |
| <input checked="" type="checkbox"/> DE Germany | <input checked="" type="checkbox"/> RO Romania |
| <input checked="" type="checkbox"/> DK Denmark | <input checked="" type="checkbox"/> RU Russian Federation |
| <input checked="" type="checkbox"/> EE Estonia | <input checked="" type="checkbox"/> SD Sudan |
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| <input checked="" type="checkbox"/> FI Finland | <input checked="" type="checkbox"/> SG Singapore |
| <input checked="" type="checkbox"/> GB United Kingdom | <input checked="" type="checkbox"/> SI Slovenia |
| <input checked="" type="checkbox"/> GE Georgia | <input checked="" type="checkbox"/> SK Slovakia |
| <input checked="" type="checkbox"/> GH Ghana | <input checked="" type="checkbox"/> SL Sierra Leone |
| <input checked="" type="checkbox"/> GM Gambia | <input checked="" type="checkbox"/> TJ Tajikistan |
| <input checked="" type="checkbox"/> GW Guinea-Bissau | <input checked="" type="checkbox"/> TM Turkmenistan |
| <input checked="" type="checkbox"/> HR Croatia | <input checked="" type="checkbox"/> TR Turkey |
| <input checked="" type="checkbox"/> HU Hungary | <input checked="" type="checkbox"/> TT Trinidad and Tobago |
| <input checked="" type="checkbox"/> ID Indonesia | <input checked="" type="checkbox"/> UA Ukraine |
| <input checked="" type="checkbox"/> IL Israel | <input checked="" type="checkbox"/> UG Uganda |
| <input checked="" type="checkbox"/> IS Iceland | <input checked="" type="checkbox"/> US United States of America |
| <input checked="" type="checkbox"/> JP Japan | |
| <input checked="" type="checkbox"/> KE Kenya | <input checked="" type="checkbox"/> UZ Uzbekistan |
| <input checked="" type="checkbox"/> KG Kyrgyzstan | <input checked="" type="checkbox"/> VN Viet Nam |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | <input checked="" type="checkbox"/> YU Yugoslavia |
| | <input checked="" type="checkbox"/> ZW Zimbabwe |
| <input checked="" type="checkbox"/> KR Republic of Korea | |
| <input checked="" type="checkbox"/> KZ Kazakhstan | |
| <input checked="" type="checkbox"/> LC Saint Lucia | |
| <input checked="" type="checkbox"/> LK Sri Lanka | |
| <input checked="" type="checkbox"/> LR Liberia | |

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☐
- ☐

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)

21-10-1998

Box No. VI PRIORITY CLAIM

☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application:* regional Office	international application: receiving Office
item (1) 22.10.97 22 October 1997	9703851-7	Sweden		
item (2)				
item (3)				

- ☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s):

* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA)
(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA / SE

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

Box No. VIII CHECK LIST: LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 3 ✓
description (excluding sequence listing part) : 4 ✓
claims : 1 ✓
abstract : 1 ✓
drawings : 1 ✓
sequence listing part of description :
Total number of sheets : 10 ✓

This international application is accompanied by the item(s) marked below:

- ☐ fee calculation sheet
- ☒ separate signed power of attorney
- ☐ copy of general power of attorney; reference number, if any:
- ☐ statement explaining lack of signature
- ☐ priority document(s) identified in Box No. VI as item(s):
- ☐ translation of international application into (language):
- ☐ separate indications concerning deposited microorganism or other biological material
- ☐ nucleotide and/or amino acid sequence listing in computer readable form
- ☐ other (specify):

Figure of the drawings which should accompany the abstract: 2

Language of filing of the international application: Swedish

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).



Hans Billberg
(Representative of the Applicant) Stockholm 1998-10-21

For receiving Office use only

1. Date of actual receipt of the purported international application:	21-10-1998	2. Drawings:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		<input checked="" type="checkbox"/> received:
4. Date of timely receipt of the required corrections under PCT Article 11(2):		<input type="checkbox"/> not received:
5. International Searching Authority (if two or more are competent): ISA / SE	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.	

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

13 NOVEMBER 1998

(13.11.98)

21 -10- 1998

1

FIGURTAVLA

Föreliggande uppfinning hänför sig till figurtavla bestående av ett underlag, vilket är belagt med flytande termokroma kristaller, som kan temperatursättas medelst individuell energitillförsel till enskilda, mot kristallerna anliggande, uppvärmbara element, som är förlagda mellan skivunderlaget och kristallerna, varigenom kristallerna antager i beroende åsatt temperatur olika färgnyanser så att härigenom kristallernas färg kan bilda ett visst mönster.

En figurtavla av nu nämnt slag är känd genom t.ex. US 4 142 782. Denna tavla innefattar ett arkliknande metallunderlag som har en yta, vilken är täckt med ett tunt skikt av vanlig färg. Skiktet är i sin tur belagt med områden av en viss termokrom komposition och vidare kan det finnas ytterligare andra områden bestående av annan termokrom komposition. Det kan finnas ytterligare områden av en ytterligare annan sort av termokrom komposition och/eller blandningar av tidigare termokroma kompositioner. Områdena kan påläggas genom målningsteknik där den termokroma kompositionen innehåller ett lämpligt bindemedel och lämpligt lösningsmedel. Vidare kan då kompositionen innehålla färgmedel eller vara färglös. Bindemedlet är vanligen färglöst för att ej störa den färgsättning som skall bildas. Vidare beskrives i detta patent att temperatursättningen av de olika områdena kan ske medelst skivliknande elektriska motståndselement som ligger mellan skivunderlaget och områdena med termokroma sammansättningar. Dessa skivliknande elektriska motståndselement uppvärmer då de enskilda kristallerna i olika områdena till viss temperatur så att kristallerna i ett område i fråga antager en viss färg beroende på temperaturen.

Enligt ovanstående beskrivna metod kan således vissa områden eller vissa punkter ges en viss färg genom att den termokroma kristallen ovanför eller i närheten av ett visst element uppvärms genom temperatursättning av elementet. Härigenom kan olika mönster bildas genom att då kristallerna med viss färg

får bilda detta mönster. Om figurtavlan bildad på ovannämnt sätt utsättes för temperaturer av omgivningen inses att det kan vara svårt att styra det mönster man önskar och vidare kan det vara svårt att övergå från ett mönster till ett annat om det nya mönstret kräver lägre temperaturer för de enskilda kristallerna än vad den föregående temperaturen varit. Avgörande är också underlagets temperatur i sammanhanget och självklart kan underlaget antaga omgivningens temperatur som då kan vara så hög att regleringen av temperaturen för de enskilda elektriska elementen ej påverkar kristallerna utan enbart omgivningens temperatur påverkar kristallerna.

Ändamålet med föreliggande uppfinning är nu att förbättra möjligheterna att temperatursätta de enskilda kristallerna och även skydda dessa mot påverkan från omgivningen både i mekaniskt hänseende och termiskt hänseende. Den framtagna bilden på figurtavlan skall också lämpligen vara programmerbar.

Uppfinningen har därför erhållit i efterföljande patentkrav angivna kännetecken och en föredragen utföringsform kommer i det följande att beskrivas med hänvisning till bifogad ritningsfigur.

Figur 1 visar därvid schematiskt en planvy av figurtavlan.

Figur 2 visar schematiskt ett snitt efter linjen II-II i figur 1.

Figur 3 visar snitt genom underliggande skivunderlaget.

Uppfinningen utgöres således av en figurtavla bestående av ett stelt skivunderlag 1. Detta skivunderlag kan vara av exempelvis metall. Ovanpå skivunderlaget finns ett antal små enskilt uppvärmbara element 3 och uppvärmningen kan t.ex. ske genom tillförsel av elektrisk spänning genom kablarna 6. Ovanpå skiktet av de uppvärmbara elementen finns ett skikt av flytande termokroma kristaller 2. Dessa termokroma kristaller kan exempelvis

2 1 -10- 1998

3

påföras i form av påmålning av en beläggningssammansättning som innehåller termokroma kristaller bundna med något bindemedel. Egenskapen hos de termokroma kristallerna är att de antager en viss färg i beroende av den temperatur som de gives. Om således
5 ett uppvärmbart element under en kristall uppvärms till viss temperatur, kommer ifrågavarande kristall att anta en viss temperatur och färg om temperaturen är högre än kristallens vilotemperatur. I figuren 1 visas hur som kristallerna 2-
erhållit en viss temperatur så att en bokstav L har bildats.
10 Bokstaven L framträder därigenom att alla kristallerna utefter L:s form av underliggande värmeelement givits en viss och samma temperatur. Omkringliggande termokroma kristaller förhåller sig passiva då deras underliggande värmeelement ej temperatsatts genom energitillförsel. Som nämnts tillföres energin för
15 uppvärmningen t.ex. därigenom att energin utgöres av ström av viss spänning.

För att skydda de termokroma kristallerna mot omgivningen så är de belagda med en skyddslack vars sammansättning senare kommer
20 att angivas.

För att snabbt kunna ändra det mönster som kristallerna skall bilda kan det vara nödvändigt att kyla kristallerna då t.ex. kristallerna skall givas en lägre temperatur än de har för att
25 antaga en annan färg. Detta kan beröra alla kristaller eller vissa kristaller. För att klara av detta skall alltså kristallerna kylas och detta kan ske därigenom att skivunderlaget 1 kyles eller hålles på en konstant temperatur som är lägre än den som gör att kristallerna färgsättes. Detta innebär att så
30 snart de uppvärmbara elementen ej längre värmesättes, nedkyles hela skivan inklusive termokroma kristallerna till den temperatur som skivunderlaget har. I figur 3 illustreras detta därigenom att skivunderlaget har en eller flera genomgående kanaler eller är utformat som en mantel så att skivunderlaget är ihålligt
35 varigenom ett kylmedel kan ledas genom skivunderlaget och hålla detta vid en konstant temperatur eller sänka temperaturen för hela figurtavlan.

Ett annat sätt att utföra denna kyleffekt är att anordna ett skikt av peltierelement under de uppvärmbara elementen. Peltierelementens egenskap är att de snabbt styres medelst energi och således kan givas en tillräckligt låg temperatur för att sänka temperaturen hos termokristallerna under den temperatur då de färgsättes. Användningen av peltierelementen kan också tillgå så att de uppvärmbara elementen 3 just utgöres av peltierelement, jämför figur 2 varvid således det som där benämnes uppvärmbara element 3 istället utgöres av peltierelement.

Det skyddslack som lämpligen användes består av akrylbas jämte syntetisk härdare och specifikt lämpligt är att blandningsförhållandet är 10:1. En sådan lack är särskilt bra beständig mot nötning och också mot UV-strålning.

Den beskrivna figurtavlan är alltså lämplig som reklamskylt emedan mönstret på tavlan (figurerna) snabbt kan ändras. Figurtavlan påverkas ej heller av omgivningens temperatur emedan underlaget kan hållas vid en konstant temperatur. Om inte skulle t.ex. solstrålning kunna påverka figurtavlan så att man ej kan styra det mönster som termokristallerna visar. Företredesvis användes elenergi dvs. strömtillförsel under viss spänning för uppvärmning av de uppvärmbara elementen och denna strömtillförsel kan vara programstyrd i vad avser spänning och också vilka uppvärmbara element som skall energimatas. Således är det möjligt att en dator programmeras av en given bild och styr signaler för energitillförsel till de uppvärmbara elementen. Själva signalerna från en dator kan även tänkas användas och eventuellt förstärkas för att åstadkomma temperaturförändring av de uppvärmbara elementen. Även styrningen av kyleffekten kan ske medelst dator.

PATENTKRAV

1. Figurtavla bestående av ett underlag (1), vilket är belagt med flytande termokroma kristaller (2), som enskilt temperatur-
5 sättes medelst individuell energitillförsel till enskilda, mot kristallerna anliggande, uppvärmbara element (3), som är förlagda mellan skivunderlaget (1) och kristallerna (2), varigenom kristallerna antager i beroende av åsatt temperaturförhöjning olika färgnyanser så att härigenom
10 kristallernas färg kan bilda olika mönster, k ä n n e t e c k n a d a v, att kristallerna har underliggande medel (4), som kan styras att avgiva kyleffekt till kristallerna (2) och/eller konstanthålla kristallernas underlag (1) vid viss önskad temperatur, som är lägre än den temperatur som färgsät-
15 ter kristallerna och att kristallerna på ovansidan över hela skivunderlaget är belagda med en skyddslack (5).
2. Figurtavla enligt krav 1, k ä n n e t e c k n a d a v, att det underliggande medlet utgöres av peltierelement som är
20 svarta och matas med elenergi för att temperaturbestämmas.
3. Figurtavla enligt krav 2, k ä n n e t e c k n a d a v, att de flytande termokroma kristallerna är målade på peltier-
25 elementen.
4. Figurtavla enligt krav 1, k ä n n e t e c k n a d a v, att skyddslacken är ett klarlack och består av akrylbas jämte syntetisk härdare.
- 30 5. Figurtavla enligt krav 4, k ä n n e t e c k n a d a v, att förhållandet mellan akrylbas och syntetisk härdare är 10:1.
6. Figurtavla enligt krav 1 och 2, k ä n n e t e c k n a d a v, att peltierelementen även utgör de enskilda medelst el-
35 energi uppvärmbara elementen (3).

21-10-1998

SAMMANDRAG

Känd figurtavla består av ett underlag (1), vilket är belagt med flytande termokroma kristaller (2). Dessa kan temperatur-
5 sättas medelst individuell energitillförsel till enskilda, mot kristallerna anliggande, uppvärmbara element (3), som är förlagda mellan skivunderlaget (1) och kristallerna (2). Kristallerna antager härigenom i beroende av åsatt temperaturförhöjning olika färgnyanser så att kristallernas färg kan
10 bilda olika mönster. För att förbättra möjligheterna att temperatursätta de enskilda kristallerna och även skydda dem mot påverkan från omgivningen både i mekaniskt och termiskt hänseende så har nu kristallerna underliggande medel (4), som kan styras att avgiva kyleffekt till kristallerna (2) och/eller
15 konstanthålla kristallernas underlag (1) vid viss önskad temperatur. Denna temperatur är lägre än den temperatur som färgsätter kristallerna. Vidare är kristallerna på ovansidan över hela skivunderlaget belagda med en skyddslack (5).

20

13-11-1998

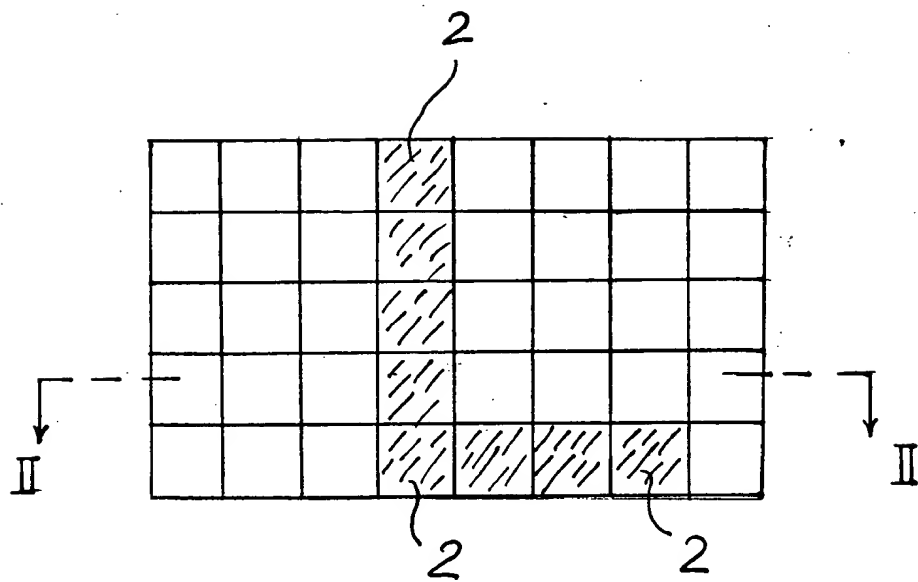


Fig 1

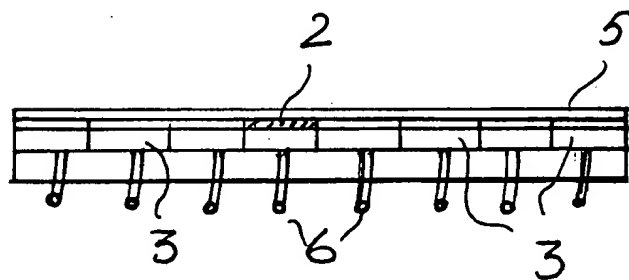


Fig 2

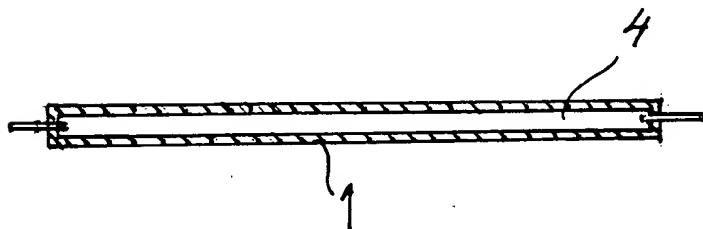


Fig 3

PCT

REQUEST

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International Application No.

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claims : 1
abstract : 1
drawings : 1
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Figure of the drawings which should accompany the abstract:

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Hans Billberg

(Representative of the Applicant) Stockholm 1998-10-21

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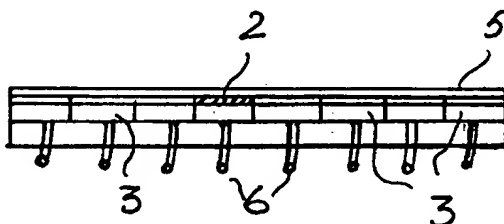
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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE98/01906 (22) International Filing Date: 21 October 1998 (21.10.98) (30) Priority Data: 9703851-7 22 October 1997 (22.10.97) SE (71)(72) Applicant and Inventor: ANDERSSON, Lars [SE/SE]; P.O. Box 14129, S-161 14 Bromma (SE). (74) Agents: MODIN, Jan et al.; Axel Ehmers Patentbyrå AB, P.O. Box 10316, S-100 55 Stockholm (SE).	(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>	

(54) Title: DISPLAY DEVICE



(57) Abstract

A known display device consists of a sheet-like support (1) which is covered with liquid thermochromic crystals (2). These are tempered by individual power supply to individual heatable elements (3), which lie close to the crystals and are placed between the sheet-like support (1) and the crystals (2). The crystals assume different shades of colour dependent on the given temperature so that hereby the colour of the crystals will form a certain pattern. In order to improve the possibilities to control the tempering of the individual crystals and also protect them from being effected by the ambient temperature and from mechanical damage, the crystals have underlying means (4) which are controlled to cool down the crystals (2) and/or keep the sheet-like support (1) of the crystals at a certain temperature. This temperature is lower than the temperature, at which the crystals are coloured. Further the crystals are covered by a coating of lacquer over the complete sheet-like support.

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DISPLAY DEVICE

This invention refers to a display device consisting of a sheet-like support, which is covered with liquid thermocromic crystals, which can be tempered by separate power supply to individual heating element, which lie close to the crystals and are placed between the sheet-like support and the crystals, whereby the crystals assume different shades of colour depending on the given temperature so that hereby the colour of the crystals will form a certain pattern.

A display arrangement of now mentioned type is disclosed in e.g. US 4142782. This display includes a sheet-like metallic support, which has a surface, which is covered with a thin layer of a conventional paint. The layer is in turn covered with areas of a certain thermocromic composition and it may also contain areas of different thermocromic composition. It may also contain areas of further different kind of a thermocromic composition and/or mixtures of the earlier mentioned thermocromic compositions. The areas will normally be created by conventional painting techniques using a coating composition containing a thermocromic compound and an appropriate conventional binder and an appropriate solvent. The composition may further include pigments of any colour or the composition can be colourless. The binder is usually colourless in order not to obscure the colour effects to be formed. It is further described in the patent that the heating of the different areas is carried out by plate-like electrical resistance elements, which are placed between the sheet-like support and the areas of the thermocromic positions. These plate-like electrical resistance elements heat the individual crystals in the different areas to a certain temperature so that the crystals in a specific area assume a certain colour depending on the temperature. According to the above described methods certain areas or certain points are given a certain colour by that the thermocromic crystals, above or in the neighbourhood of a certain heating element are heated. Different patterns

will hereby be formed by that the crystals having a certain colour will form a certain pattern. If the display however is subjected to the ambient temperature, one can understand that it may be difficult to control the pattern so it has the
5 wanted design and it can also be difficult to change the pattern from one design to another if the new pattern demands a lower temperature for the individual crystals than the earlier temperature. The temperature of the sheet-like support is thus of great importance and the sheet-like support may assume the
10 ambient temperature, which can be so high that the control of the temperature for the individual electrical element have no effect on the crystals but it is only the ambient temperature which has an effect on the crystals.

15 The object of the invention is to increase the possibilities to control the tempering of the individual crystals and also protect them from being effected by the ambient temperature and also from mechanical damage. The produced picture on the display shall also be possible to program.

20 The invention is characterized by the features stated in the following patent claims and a favourable embodiment is described in the following by reference to accompanying drawings.

25 Fig. 1 is thereby a schematic view a display according to the invention.

30 Fig. 2 is a schematic section according to the lines II-II of fig. 1.

Fig. 3 is a section through the underlying sheet-like support.

35 The invention is thus a display device consisting of a stiff sheet-like support 1. The sheet-like support could be made for instance of metal. Several small separately heatable elements 3 are arranged on the sheet-like support and the heating is

performed by supplying an electrical voltage through cables 6 to the elements 3. A layer of liquid thermocromic crystals 2 cover the layer of the heatable elements. The liquid thermocromic crystals may be applied by painting of a coating composition which contains thermocromic crystals, which are bound by a binder. The characteristic of the thermocromic crystals is that they assume a certain colour in correspondence to their given temperature. If thus a heatable element below a crystal is heated to a certain temperature, said crystal will assume said temperature and is coloured if the temperature is higher than the temperature at rest of the crystal. Fig. 1 shows that the crystals 2 have been given a certain temperature so that a letter L has been formed. The letter L appears by that all the crystals along the shape of L have been given the same certain temperature by the underlying heatable element. The thermocromic crystals outside L remain passive because their underlying heatable element have not been heated by voltage supply. As said earlier the power for heating the elements can take place by supplying a current of a certain voltage.

The thermocromic crystals are covered by a coating of lacquer in order to protect the crystals to the surroundings, the composition of said coating of lacquer being stated later.

In order to quickly be able to change the pattern, formed by the crystals, it could be necessary to cool down the crystals, if the crystals must be given a lower temperature than the one they have in order to assume a different colour. This could concern all the crystals or certain crystals. All the crystals shall thus be cooled down and this can be done by that the sheet-like support 1 is cooled down or is kept on a constant temperature which is lower than the temperature which makes the crystals to assume a certain colour. This means that as long as the heatable element are not heated any longer, the whole display device including the thermocromic crystals will be cooled down to the temperature of the sheet-like support.

This is illustrated in fig. 3 by that the sheet-like support has one or several continuous channels or is designed like a jacket so that the sheet-like support is hallow whereby a cooling medium can pass through the sheet-like support and keep it at a constant temperature or lower the temperature for the complete display device.

A further way to carry out the refrigerating capacity is to arrange a layer of peltier elements under the heatable elements. The characteristic of a peltier element is that it very quickly is controlled by means of electrical energy and thus can be given an enough low temperature in order to lower the temperature of the thermocromic crystals under the temperature at which they are given a certain colour. The peltier elements can also be used instead of the heatable elements 3, see fig. 2 whereat thus the heatable elements 3 are peltier elements.

The kind of coating of lacquer which is used consists suitably of an acryl base and synthetic agent and it is specifically suitable that the mixing proportion is 10:1. Such a lacquer is very resistant to wearing and also UV-radiation. The described display device is thus suitable as an advertising sign, because the pattern on the display (figures) can be altered rapidly. The display device is not effected by the ambient temperature because the sheet-like support is kept at a constant temperature. If not, the sunshine could effect the display so that it is not possible to control the pattern which the thermocromic crystals should show. Electrical energy is preferably used, e.g. supply of current of a certain voltage, for heating the heatable elements and the supply of current can be program-controlled concerning the voltage and also which of the heatable elements that should be supplied by power. Thus a computer may be programmed by a certain picture and accordingly controls the signals for the power supply to the heatable elements. The signals of a computer can also be used and possibly amplified in order to bring about the change

of temperature of the underlying means. The computer can also control the refrigeration.

CLAIMS

1. Display device consisting of a sheet-like support (1) which is covered with liquid thermocromic crystals (2), which are separately tempered by individual power supply to individual heatable elements (3), which lie close to the crystals and are placed between the sheet-like support (1) and the crystals (2), whereby the crystals assume different shades of colour dependent on the given temperature so that hereby the colour of the crystals will form a certain pattern, **characterized by** that, the crystals have underlying means (4) which are controlled to cool down the crystals (2) and/or keep the sheet-like support (1) of the crystals at a certain temperature, which is lower than the temperature, at which the crystals are coloured and further **characterized in** that the crystals are covered by a coating of lacquer over the complete sheet-like support.
2. Display device according to claim 1, **characterized in** that the underlying means consists of peltier elements, which are black and are supplied by electricity in order to set their temperature.
3. Display device according to claim 2, **characterized in** that the liquid thermocromic crystals are painted on the peltier elements.
4. Display device according to claim 1, **characterized in** that the coating of lacquer is a plain lacquer and consists of an acryl base and a synthetic agent.
5. Display device according to claim 4, **characterized in** that the mixing proportion between the acryl base and the synthetic agent is 10:1.

6. Display device according to claim 1 and 2, characterized in that the peltier elements also are the individual heatable elements (3), which are heated by electricity.

1/1

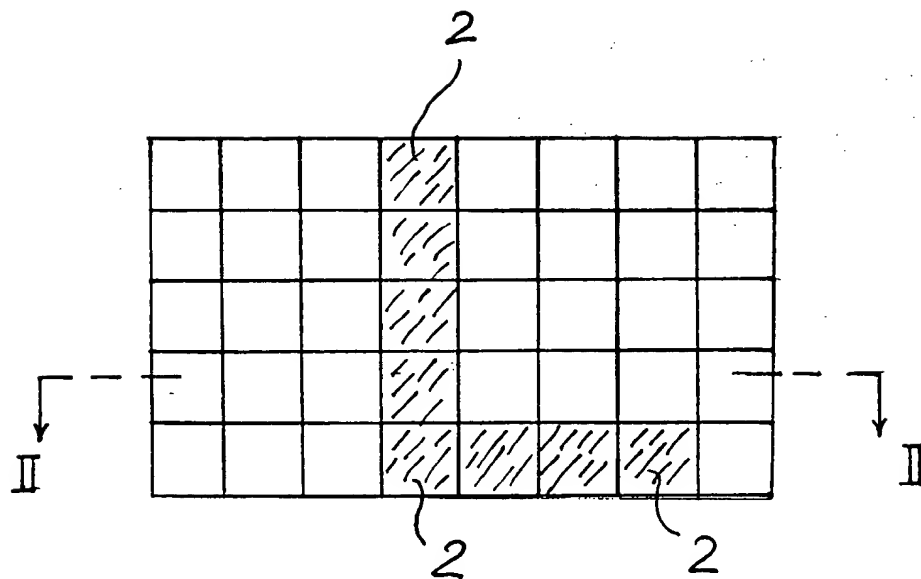


Fig 1

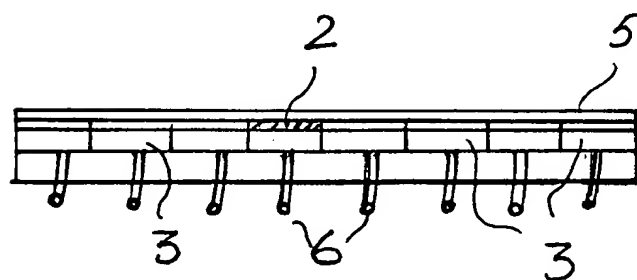


Fig 2

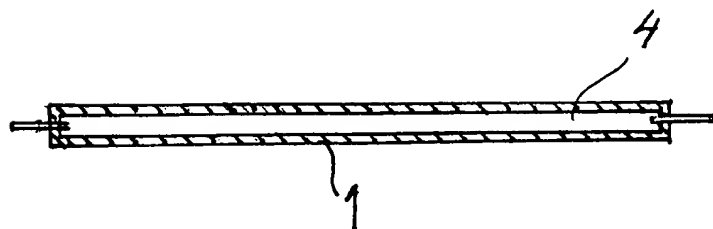


Fig 3

1
INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01906

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G02F 1/13, G09F 9/35

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G02F, G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5202677 A (ROBERT PARKER ET AL.), 13 April 1993 (13.04.93), column 14, line 60 - column 15, line 8, figure 15 --	1,4,5
Y	US 4142782 A (EDWARD D. O'BRIAN), 6 March 1979 (06.03.79), column 4, line 35 - line 47, figure 3 --	1,4,5
Y	GB 2199981 A (LIQUID CRYSTAL DEVICES LIMITED), 20 July 1988 (20.07.88), page 10, line 35 - page 11, line 12 --	1,4,5

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 January 1999

Date of mailing of the international search report

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2
INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01906

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4834500 A (KERR, BERKSHIRE ET AL.), 30 May 1989 (30.05.89), column 2, line 23 - column 3, line 26 --	1-6
A	US 5124819 A (FREDERICK DAVIS), 23 June 1992 (23.06.92), column 2, line 27 - column 3, line 24 -- -----	1-6

INTERNATIONAL SEARCH REPORT
Information on patent family members

21/12/98

International application No.

PCT/SE 98/01906

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	5202677	A	13/04/93	AU 1361892 A WO 9214234 A	07/09/92 20/08/92
US	4142782	A	06/03/79	NONE	
GB	2199981	A	20/07/88	NONE	
US	4834500	A	30/05/89	EP 0132077 A,B GB 2143323 A,B JP 1853498 C JP 60052890 A	23/01/85 06/02/85 07/07/94 26/03/85
US	5124819	A	23/06/92	US 4952033 A US 5058999 A	28/08/90 22/10/91